

CLAIMS

1. A light-emitting diode comprising: at least one semiconductor light-emitting device mounted over the surface of a lead frame; and a transparent resin package covering the semiconductor light-emitting device,

5 wherein the resin package includes

a base portion covering a base part of the lead frame,

an expansion portion provided at a side of the base portion toward a principal-light-emitting surface of the semiconductor light-emitting device and having a side face which is a first curved face capable of causing total reflection of light emitted from the semiconductor light-emitting device and making the reflected light released toward the front, and

a contraction portion located between the expansion portion and the base portion and has a lateral cross section smaller than a maximum lateral cross section of the base portion.

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2. The light-emitting diode of claim 1, wherein a convex lens portion for concentrating, toward the front, light emitted from the semiconductor light-emitting device is provided in a surface part of the resin package, and a diffusing part for diffusing light emitted from the semiconductor light-emitting device toward the sides is formed in a part of the convex lens portion intersecting an optical axis of the convex lens portion.

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3. The light-emitting diode of claim 2, wherein the diffusing part is flat.

4. The light-emitting diode of claim 2, wherein a part of the convex lens portion surrounding the diffusing part is a convex-lens side face, and

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a recess whose side wall is partly the convex-lens side face is provided to surround the convex lens portion.

5 5. The light-emitting diode of claim 1, wherein the first curved face of the expansion portion has a lateral cross section including an arc using an optical axis of the semiconductor light-emitting device as the center of the arc.

6. The light-emitting diode of claim 1, wherein a plurality of said semiconductor light-emitting devices are provided, and
10 the first curved face of the expansion portion has a lateral cross section formed by connecting arcs using optical axes of the semiconductor light-emitting devices as the centers of the arcs.

7. The light-emitting diode of claim 1, wherein the first curved face of the
15 expansion portion includes a paraboloid of revolution.

8. The light-emitting diode of claim 1, wherein part of the lead frame projects from the resin package,
the base portion projects from the contraction portion along the direction in which
20 the lead frame projects, and
a backside end of the base portion has a width equal to that of a front-side end of the contraction portion in a direction perpendicular to the direction in which the lead frame projects.

25 9. The light-emitting diode of claim 1, wherein the semiconductor light-emitting

device is mounted over the lead frame with a submount device interposed therebetween.

10. The light-emitting diode of claim 1, wherein a phosphor is printed on the semiconductor light-emitting device.

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11. The light-emitting diode of claim 1, wherein a plurality of said semiconductor light-emitting devices are provided, and

the semiconductor light-emitting devices are arranged along a direction perpendicular to the direction in which the lead frame projects.

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12. The light-emitting diode of claim 1, wherein the lead frame bends into a gull-wing shape.

13. The light-emitting diode of claim 2, wherein the optical axis of the convex lens portion coincides with an optical axis of the semiconductor light-emitting device.

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14. The light-emitting diode of claim 2, wherein no part of the convex lens portion projects from a portion of the surface of the resin package closest to the front.

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15. The light-emitting diode of claim 2, wherein a plurality of said semiconductor light-emitting devices are provided, and

the convex lens portion is provided in each of the semiconductor light-emitting devices.

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16. The light-emitting diode of claim 1, wherein at least three said semiconductor

light-emitting devices emitting red light, green light and blue light, respectively, are provided.

17. The light-emitting diode of claim 1, wherein a plurality of said semiconductor
5 light-emitting devices emitting light of the same color are provided,

the semiconductor light-emitting devices includes p-electrodes and n-electrodes,

the lead frame includes a first frame connected to the p-electrodes and provided
with a pair of terminals projecting from the resin package in plan view and also includes a
second frame connected to the n-electrodes and provided with a pair of terminals
10 projecting from the resin package in plan view, and

the terminals of the first frame are point symmetric with respect to a center of the
resin package, and the terminals of the second frame are point symmetric with respect to
the center of the resin package.

15 18. The light-emitting diode of claim 17, wherein the terminals of the first frame
are continuous, and

the terminals of the second frame are apart from each other with the first frame
sandwiched therebetween.

20 19. The light-emitting diode of claim 17, wherein head parts of the respective
terminals of the first frame are parallel to head parts of the respective terminals of the
second frame, and

the semiconductor light-emitting devices are arranged along a direction
perpendicular to the head parts of the terminals of the first frame and the head parts of the
25 terminals of the second frame.

20. The light-emitting diode of claim 17, wherein the first frame includes a device fixing part for fixing back faces of the semiconductor light-emitting devices, and the terminals of the first frame extend in opposite directions respectively from both ends of the device fixing part along a direction perpendicular to a longitudinal direction of the device fixing part, and

base parts of the respective terminals of the second frame are located near the device fixing part, and head parts of the respective terminals of the second frame are parallel to the terminals of the first frame.

21. The light-emitting diode of claim 20, wherein a base part of each of the terminals of the second frame bends toward adjacent one of the terminals of first frame in the resin package.

22. A light-emitting diode comprising: at least one semiconductor light-emitting device mounted over the surface of a printed wiring board; and a transparent resin package covering a front side of the semiconductor light-emitting device,

wherein the resin package includes an expansion portion having a side face which is a first curved face capable of causing total reflection of light emitted from the semiconductor light-emitting device toward the sides and making the reflected light released toward the front, and

the semiconductor light-emitting device is mounted in a recess provided in the printed wiring board.

23. The light-emitting diode of claim 22, wherein a side face of the recess in the

printed wiring board expands toward the front, and

a part of the resin package in contact with the side face of the recess is a second curved face.

5 24. The light-emitting diode of claim 23, wherein a backside end of the first curved face is connected to a front-side end of the second curved face.

25. The light-emitting diode of claim 23, wherein an electrode made of a metal is provided on part of the surface of the printed wiring board, and

10 a film made of the same metal as the metal constituting the electrode is interposed between the second curved face of the resin package and the printed wiring board.